

513
G61b
pt.2

 Bell's
Outdoor and Indoor
Experimental
Arithmetics

Second Year's Course
(Standard IV)

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pt. 2

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OUTDOOR AND INDOOR EXPERIMENTAL ARITHMETIC.

SECOND YEAR'S COURSE.

SECTION I.—LENGTH.

The Pole.

(a) Find the line marked on the playground, which is *pole* in length.

(b) By means of your tape measure, find

(i) How many *yards* are contained in 1 pole.

(ii) „ „ *feet* „ „ 1 pole.

(c) Record your results thus :

1 pole = yards = feet.

Diagram shewing Pole, Yards and Feet.

In your permanent note-books draw a diagram shewing pole divided into $5\frac{1}{2}$ yards, and 1 yard divided into 3 feet. (Scale 1 in. to 1 yd.)

3. Number of Bricks in a Length of One Pole.

(a) Knowing the length of 1 brick (First Year's Course, Ex. 7), calculate how many bricks, placed lengthways, will be required to make a distance of 1 pole.

(b) Check your results by measuring a length of 1 pole on the playground wall, and counting the number of bricks in that length.

4. Number of Foot-Lengths in a given Distance.

(a) By placing the heel of one foot against the toe of the other (Fig. 1), find out how many lengths of your own feet make a distance of 1 pole.

(b) Hence *calculate* the length of your own foot (in inches).

(c) *Measure* the length of your own foot in inches.



FIG. 1.

(d) Enter your results thus :

	Distance to be Stepped.	No. of Foot-Lengths.	Length of Own Foot from Calculation	Actual Length of Own Foot.	Error.
<i>e.g.</i>	1 pole	28	7 ins. (just over)	$7\frac{1}{2}$ ins.	Slight

5. Measurement of Distance by means of your Foot.

(a) Knowing the length of your foot (found in Ex. 4), calculate the number of your foot-lengths required to make a distance of 2 poles.

(b) From a given starting point, proceed as in Ex. 4, making the number of foot-lengths required. Mark your halting-position (toe) with a piece of chalk.

(c) By means of the tape measure, now find the actual distance you have stepped.

Record results thus :

	Distance.	Length of Own Foot.	No. of Foot-Lengths	Actual Distance.	Amount of Error.
<i>e.g.</i>	2 poles = 11 yds.	8 ins.	$49\frac{1}{2}$	11 yds. 2 ft. 9 ins.	2 ft. 9 ins.

6. Finding Length of Stride.

(a) From the line marked on the playground walk 10 ordinary strides.

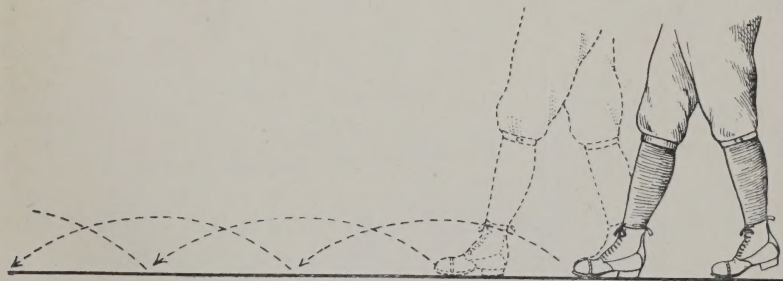


FIG. 2

(b) Mark your halting position (heel) with a piece of chalk.

(c) By means of the tape measure, find the exact length of this distance.

(d) Now calculate the length of 1 stride.

7. Striding a Distance.

(a) Knowing the length of your stride (found in Ex. 6), calculate how many strides you must take to walk a distance of 22 yards.

(b) From the line marked on the playground, make the number of strides (found in Ex. 7 (a)).

Mark your halting position (heel) with a piece of chalk.

(c) By means of the tape measure, find the exact distance you have walked.

(d) Make the following table in your note-book, and complete :

Distance to be Stepped.	From Ex. 6 (d).	From Ex. 7 (a).	From Ex. 7 (c).	Amount of Error.
	Length of Stride.	No. of Strides required.	Actual Distance.	
<i>e.g.</i> 22 yds.	2 ft. 7 ins.	25 + 1 ft. 5 ins. more	21 yds. 0 ft. 2 ins.	2 ft. 10 ins.

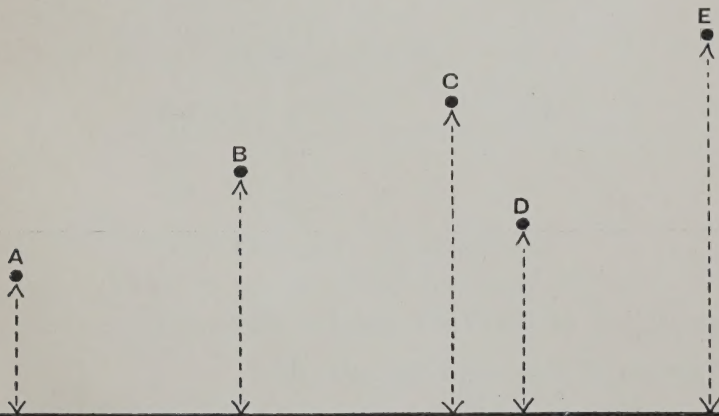
8. Judging Distance in Yards.

(a) Judge the distances of children from the line marked on the playground.

(b) With your tape measure find the exact distance, and then calculate your error.

(c) Complete the following table :

Scholar.	Estimated Distance.	Actual Distance.	Amount of Error.
<i>e.g.</i> A	4 yds.	5 yds. 1 ft. 7 ins.	1 yd. 1 ft. 7 ins.
B			
C			
D			
E			



Line from which distances of Scholars should be estimated.

FIG. 3.—Judging Distance.

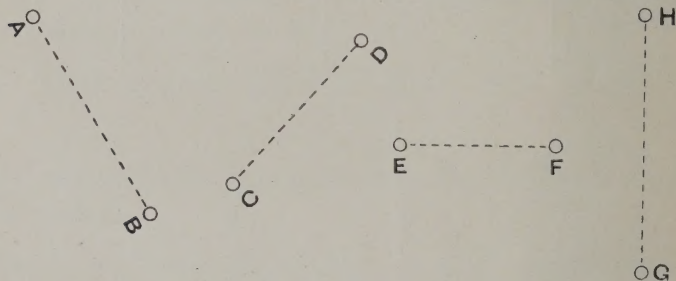
9. More Difficult Estimation in Yards.

(a) Estimate by sight the distances between pairs of children placed in certain positions by your teacher.

(b) Find the actual distance between each pair, by means of the tape measure.

(c) Record results, and complete the following table :

	Pair.	Estimated Distance.	Actual Distance.	Amount of Error.
e.g.	A	3 yds.	4 yds. 2 ft. 5 ins.	1 yd. 2 ft. 5 ins.
	B			
	C			
	D			
TOTAL ERROR =				



SCHOLARS ON THIS LINE.

FIG. 4.

10. Comparison of the Yard and the Metre.

By means of your tape measure, find

(a) How many inches there are in 1 yard.

(b) „ whole inches „ 1 metre.

Which is the greater and by how much (roughly) ?

11. Number of Foot-Lengths in a Metre.

(a) By placing the heel of one foot against the toe of the other, find out how many lengths of your feet are required to make a distance of 5 metres.

(b) Hence calculate the number of your foot-lengths required to make a distance of 1 metre.

12. Estimation of Dimensions.

(a) Estimate, to the nearest *half-inch*, the length and breadth of the pieces of cardboard given to you.

(b) Measure the same with your ruler.

(c) Record your results thus :

	Card.	Exercise.	Length.	Breadth.
e.g.	E	(i) Estimated at	$3\frac{1}{2}$ ins.	$2\frac{1}{2}$ ins.
		(ii) Actual Measurements	$3\frac{1}{4}$ ins.	$2\frac{1}{2}$ ins.
		(iii) Amount of Error	$\frac{1}{4}$ in.	—
	B			

13. Further Estimations.

Repeat the above exercise with rectangular pieces of cardboard, but estimate to the nearest *quarter-inch*.

14. Dimensions of Boxes.

(a) Estimate, to the nearest *quarter-inch*, the length, breadth, and depth of the boxes given to you.

(b) Take the measurements of the boxes ; enter results, and complete the following table :

No. of Box.	Exercise.	Length.	Breadth.	Depth.
	(i) Estimated at			
	(ii) Actual Measurements			
	(iii) Amount of Error			

15. The Length of the Decimetre.

- Draw a line on your book 8 ins. in length.
- Underneath it draw a line 2 decimetres (2 dm.) long.
- By comparing these two lines, what result can you find ?
- Write down the nearest number of inches which is equal in length to 1 dm.

16. Estimating Length in Decimetres.

(a) Estimate, in *decimetres*, the lengths of the pieces of string suspended before you.

(b) Make the following table in your note-book, and enter results as you proceed :

String.	Estimated Length.	Actual Length.	Amount of Error.
<i>e.g.</i> <i>A</i> <i>B</i> <i>C</i> <i>D</i> <i>E</i>	9 dm.	10 dm. = 1 metre	1 dm.
TOTAL ERROR =			

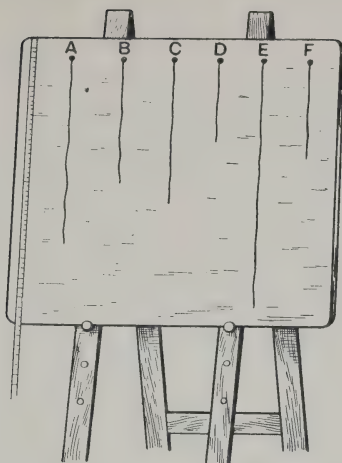


FIG. 5.—Lengths of String.

17. Estimations in English and Metric Units.

Estimate, in *feet and inches* and also in *metres and decimetres*, the lengths of the following articles in your classroom. Make a table, as below, and enter results :

Article to be Estimated.	I. English Measurements.			II. Metric Measurements.		
	Estimated at	Actual Length.	Amount of Error.	Estimated at	Actual Length.	Amount of Error.
Scholar's Desk, Length of						
Teacher's Desk, ,,						
Blackboard, ,,						
Width of						
Easel. ,, Width of Top						
Map-Pole, Length of						
Door, Height of						
	TOTAL ERROR			TOTAL ERROR		

18. Graph of own Height.

(a) Measure your height at regular intervals, and record your results as shewn by the graph.

(b) Insert also the average height of the class as indicated.

(c) By how much does your height differ from the average height?

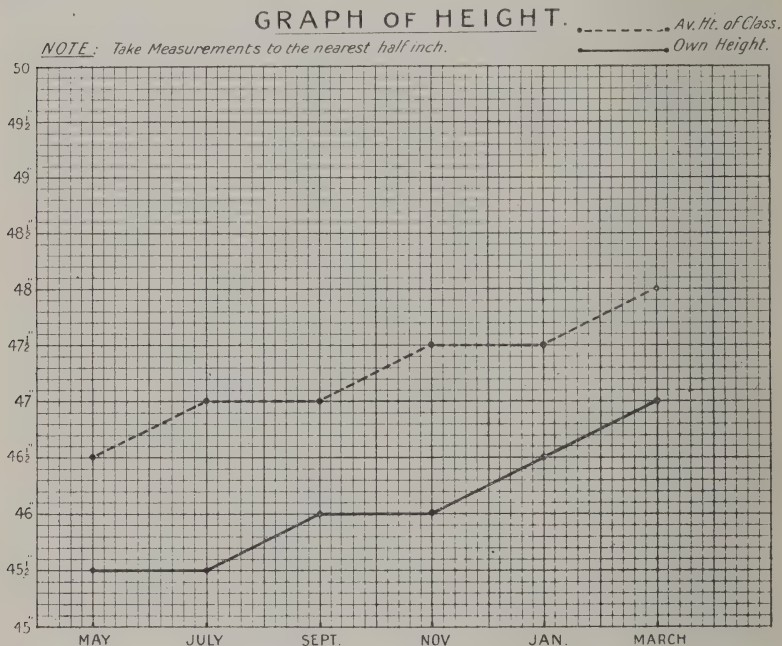


FIG 6.

SECTION II.—AREA.

19. Areas of Squares.

- (a) Construct two squares with sides of 3 ins.
 (b) Divide them into inch squares.
 (c) Cut them out, and lay them side by side (Fig. 7).

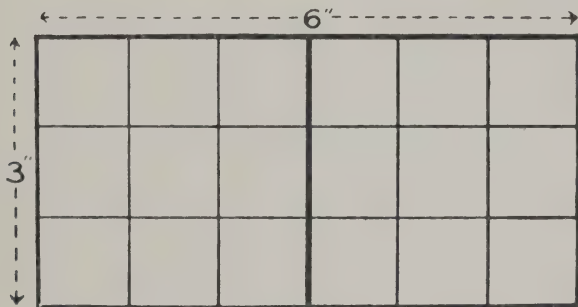


FIG. 7.

(d) Write down answers to the following :

- | | | |
|---|---|----------|
| (i) Area of two squares | = | sq. ins. |
| (ii) Length of two squares side by side | = | ins. |
| (iii) Width of one square | = | ins. |

(e) Say how you could find out the area of the two squares together, without counting.

(f) Write down the name of the figure which the above diagram represents.

20. Areas of Rectangles.

(a) Construct and cut out rectangles of the following sizes, and calculate their areas:—(i) 5 ins. by 2 ins., (ii) 4 ins. by 3 ins., (iii) 6 ins. by 7 ins.

(b) Prepare the following table, and enter your results :

No.	Length of Long Side.	Length of Short Side.	Area.
(i)			
(ii)			
(iii)			

21. Estimation of Areas.

(a) Examine the rectangular cardboard figures given to you, and *estimate* their dimensions, from which *calculate* their areas.

(b) Measure the sides ; enter results, and complete the following table :

	Exercise.	Length.	Breadth.	Area.
	(i) Estimated at	ins.	ins.	sq. ins.
	(ii) Actual Measurements	ins.	ins.	sq. ins.
	(iii) Amount of Error	ins.	ins.	sq. ins.

22. Square Half-Inches.

(a) Construct a square with sides $2\frac{1}{2}$ in. long, and mark off the half-inches all round.

(b) Divide the square into square half-inches (Fig. 8).

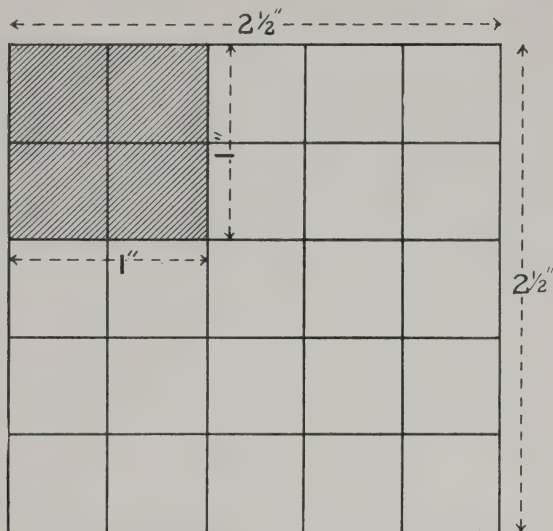


FIG. 8.

(c) Shade four of the squares, as shewn in diagram, and then write answers to the following questions :

- (i) How long is one side in half-inches ?
- (ii) What is the area in square half-inches ?
- (iii) How many " long " half-inches make an inch ?
- (iv) ,, square ,, a square inch ?
- (v) What part of a sq. inch is a sq. half-inch ?
- (vi) How many sq. inches are there in the large square ?

23. Number of Squares contained in a Rectangle.

(a) Measure the lengths of the sides of the square piece of cardboard given to you, and calculate its area in sq. inches.

(b) Write down your result as follows :

(i) Length of side = ins.

(ii) $\therefore$ area of square = sq. ins.

(c) Measure the sides of the square or rectangle chalked on the floor, and calculate its area as before.

(d) Find how many pieces of cardboard, similar to the one you have, would be required to cover exactly the figure on the floor.

Write down your results thus :

(i) Area of rectangle on floor = sq. ins.

(ii) „ cardboard square = sq. ins.

(iii) Number of pieces required =

Note.—Test your result (iii) by covering the figure on the floor with your pieces of cardboard.

24. The $5\frac{1}{2}$ Inch Square.

(a) Construct a square with side $5\frac{1}{2}$ ins. long.

(b) Mark off inches along the sides, and divide the square into sq. ins. as far as you can.

(c) Shade the half-squares and the tiny squares in the corner, as shewn in the diagram (Fig. 9).

(d) Cut out all the shaded portions, and place the half-squares side by side to form squares (Fig. 10).

(e) Write down answers to the following :

- (i) Number of whole inch squares = sq. ins.
- (ii) „ halves of „ „ = sq. ins.
- (iii) What part the small square is of an inch square
- (iv) Total area of the square = sq. ins.

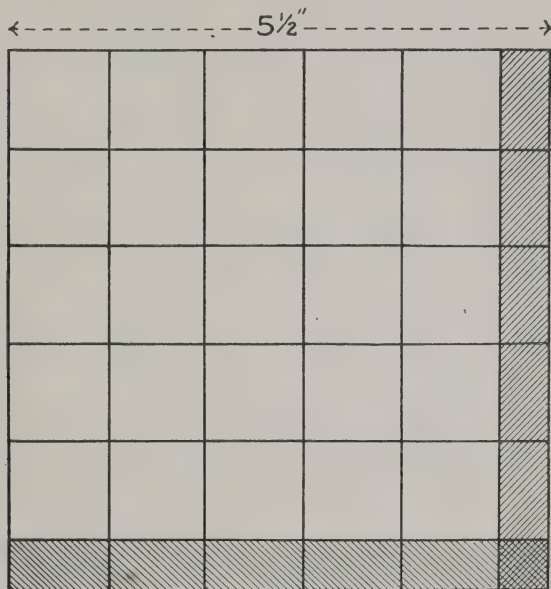


FIG. 9.

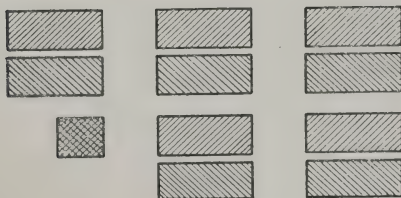


FIG 10.

25. The Square Pole drawn to Scale.

Let each inch represent a yard, and then write down answers to the following :

- (i) Length of side of square = yds.
 (ii) Area of square = sq. yds.

26. The Square Pole.

(a) Measure the dimensions of the sq. pole laid down in the playground.

(b) Draw one in chalk equal in area.

(c) Write down its dimensions and area from what you know :

- (i) Length = yards.
 (ii) Area = sq. yds.

(d) Write down the name of this area :

A SQUARE POLE.

27. The Square Metre and Square Yard.

(a) Examine the square metre laid down in the playground, and carefully compare it with the square yard.

(b) Make the following measurements and calculations :

- (i) Length of side of sq. yd. in *inches* = inches.
 (ii) „ „ sq. metre „ = „
 (iii) Area of sq. yd. in *sq. ins.* = sq. ins.
 (iv) „ sq. metre „ = „

28. The Square Decimetre.

(a) Construct a square with side 10 cms. or 1 decimetre (1 dm.) long.

(b) Divide it into squares, each side being 2 cms. (Fig. 11).

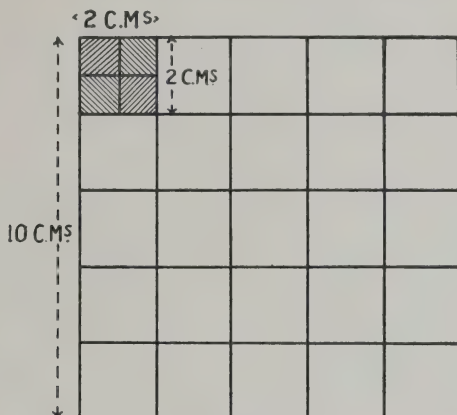


FIG. 11.

(c) Divide one square into sq. cms., as shewn in diagram (Fig. 11).

(d) Write answers to the following :

- (i) How many large squares are there ?
- (ii) How many sq. cms. make one large square ?
- (iii) „ „ „ the whole sq. decimetre ?
- (iv) What part of a sq. decimetre is a sq. centimetre ?
- (v) Measure the length of one side of the sq. decimetre, in inches, as nearly as you can.
- (vi) What is *about* the area of a sq. decimetre in sq. ins. ?
- (vii) From (iii) and (vi) find *about* how many square cms. make a square inch.

SECTION III.—VOLUME AND CAPACITY.

29. The Four-Inch Cube.

(a) From cardboard construct a cube to the given dimensions (Fig. 12), in the same manner as you made the 2 inch cube. Take care that the cube measures *fully* 4 ins. *inside*.

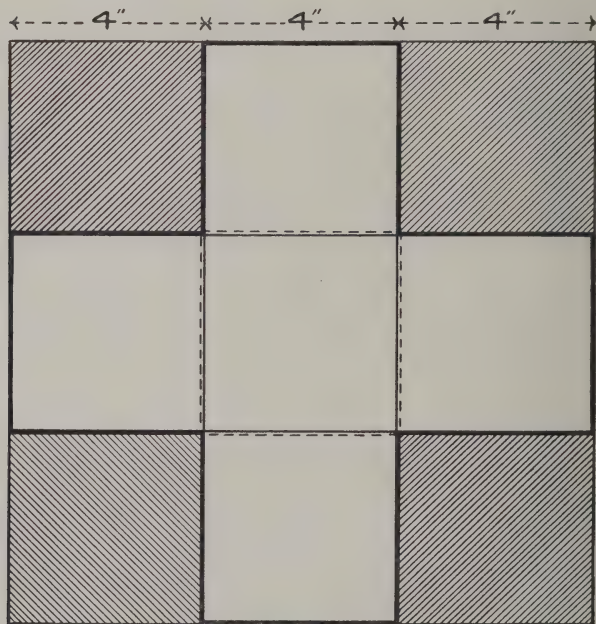


FIG. 12.

(b) How many one-inch cubes were required to fill the cube of 2 ins. side? Write this result in your note-book, as shewn on page 19.

(c) Construct a cardboard tray to the dimensions given in Fig. 13, and fill it with 1 in. cubes.

(d) How many cubes does it hold ? Enter your answer.

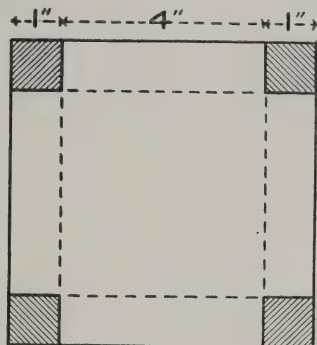


FIG. 13.

(e) How many of these trays could you place in the cube ? Try to borrow enough to see if your result is correct.

(f) How many inch cubes would you need to fill the 4 in. cube ?

(g) What rule have you previously learnt for finding the volume of a cube ?

(h) Write this rule under your results, and work out the answer for the 4 in. cube. Compare this result with your previous one.

Object.	Length.	Width.	Height.	Number of Inch Cubes in it.
2 ins. cube	2 ins.	2 ins.	2 ins.	8
Tray	4 ins.	4 ins.	1 in.	
4 ins. cube	4 ins.	4 ins.	4 ins.	

VOLUME OF CUBE =

30. The One-Foot Cube.

(a) Look carefully at the large cube before you. Measure its edges, as instructed by your teacher.

(b) Make a sketch ($\frac{1}{3}$ size) in your note-book, and insert its dimensions.

(c) Watch your teacher as each of the movable parts is taken off, and make a drawing of each part, shewing its dimensions.

(d) What is the size and shape of the small corner-piece *D*?

(e) In your drawings of the pieces *C* and *D*, shew, as clearly as you can, how many small cubes there are in the two pieces together.

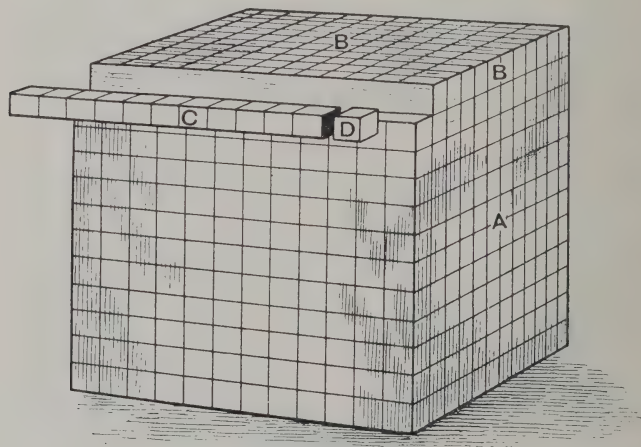


FIG. 14.



FIG. 14A.

(f) Now look at the whole top (D , C and B) of the large cube.

(i) How many *rows*, such as D and C , does it contain ?

(ii) How many *small cubes* does it contain ?

(g) Placing the whole top together, how many such slabs would it take to build a cube the same size as the one before you ?

(h) What name would you give to such a cube ?

(i) Arrange all your answers as shewn below, entering your results in the spaces provided :

$D = 1$ inch cube.

D and $C =$ inch cubes.

B , D and $C =$ rows = cubes.

A , B , D and $C =$ layers = rows = cubes.

$\therefore 1$ cubic foot = cubic inches.

31. Volume of Air.

(a) In your note-book rule columns, as shewn on page 23.

(b) Look carefully at the wire-cube, noticing its shape and size.

(c) What does this cube contain ? How much does it enclose ?

(d) Watch the wire-cube while it is moved along the side of the class-room wall (Fig. 15).

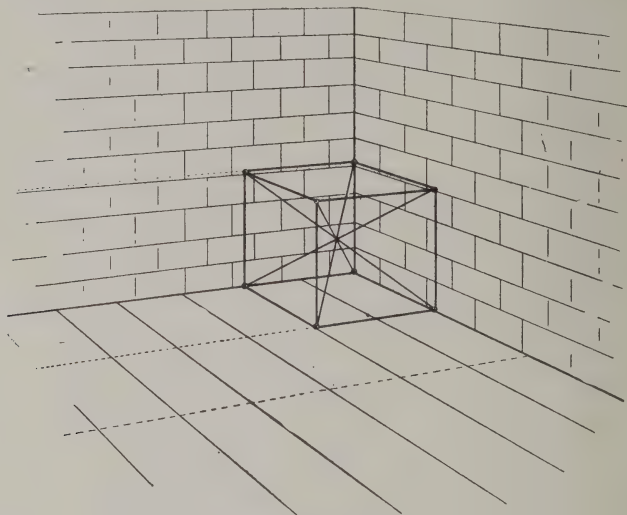


FIG. 15.—The Hollow Cube in use.

(e) What is the volume of the air 1 foot high and 1 foot wide against the wall ?

Write down the first line of your table.

(f) What would be the volume of air 1 foot high and 2 feet wide extending along the same wall ?

Write your answer below.

(g) Measure the width of the room.

What would be the volume of air 1 foot high and extending the whole length and width of the room ?

Write your answer.

(h) Find also, by measuring the height of the room to a given mark, the volume of air in the room to the height of that mark.

LENGTH OF ROOM = 20'. WIDTH = 18'.

	Length.	Width.	Height.	Volume.
from (e)	20 ft.	1 ft.	1 ft.	20 cubic feet
„ (f)	20 ft.	2 ft.	1 ft.	
„ (g)	20 ft.	18 ft.	1 ft.	
„ (h)	20 ft.	18 ft.	5 ft. (to mark A)	

32. Volume of a Brick.

(a) Re-measure the length, breadth and thickness of a brick (Fig. 16).

(Measure to the nearest half-inch.)

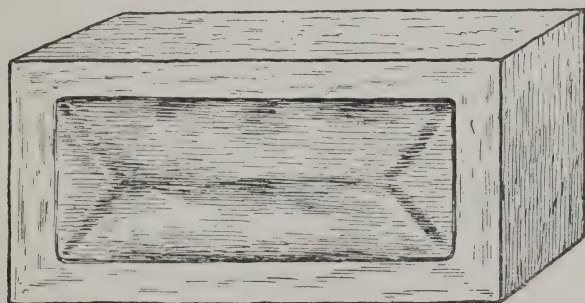


FIG. 16.—The Brick.

(b) From these measurements find the volume of the brick, in cubic inches, as nearly as you can.

(c) Draw three different views of the brick (half-size) in your note-book.

33. The Cubic Decimetre.

(a) Cut out from cardboard and construct a cubic decimetre, using the same methods as in Exercise 29.

(b) Fill your cubic decimetre with sand (see Fig. 17).

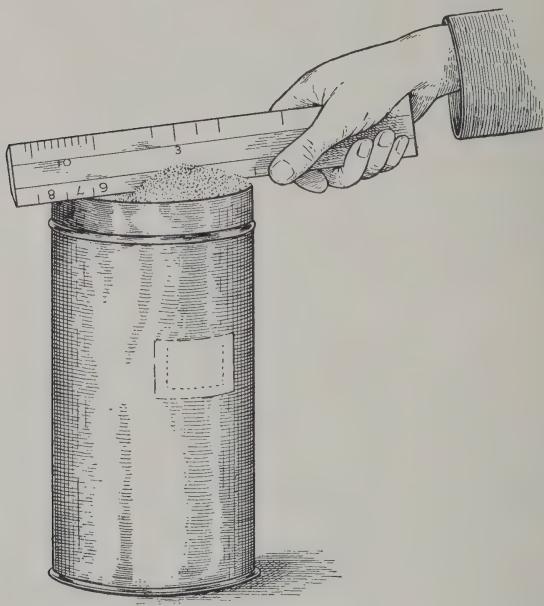


FIG. 17.—How to fill a Vessel with Sand.

(c) Take the 4 in. cube that you made in Ex. 29, and empty the sand into it from the cubic decimetre.

(d) In your note-book make a comparison between the cubic decimetre and the 4 in. cube (for example, “smaller,” or “slightly larger”).

34. The Gill.

(a) Take an ordinary tumbler, and pour into it a quarter of a pint, or gill, of sand.

(Use the gill measure.)

(b) Mark the height of sand in the tumbler by a strip of paper.

(c) This will now serve as a gill measure. Notice its size carefully.

(d) Find whether your tumbler will hold 2 gills.

(e) If so, mark the height again, and you will then have two measures in your tumbler.

(f) What is another name for 2 gills ?

35. The Cubic Decimetre and the Litre.

(a) In your note-book make sketches of the objects before you, viz. :

- (i) Your own cubic decimetre,
- (ii) The litre measure,
- (iii) The pint measure,
- (iv) The quart measure.



FIG. 18.

Make your drawings, as nearly as you can, *half* the size of the actual objects, and on each, print its name.

(b) Now carefully fill the cubic decimetre with sand, and empty it into the litre measure.

(c) Print on your sketch of the litre whether it is larger than, equal to, or less than the cubic decimetre.

36. The Litre, Pint and Quart.

(a) By filling your tumbler to the gill-mark with sand, find how many *gills* are contained in a *litre* (Fig. 19).



FIG. 19.

(b) Write the result on your sketch of the litre, which you made in Ex. 35.

1 litre = gills.

(c) From this, how many *pints* are there in a *litre* ?

(d) Using the sand method, find how many *gills* there are in a *quart*.

Write the result on your sketch of the quart measure.

(e) Now write down and complete the following statements :

1 litre	=		gills.
1 quart	=		gills.
∴ 1 litre	=		of a quart, or pints.

37. The Gallon.

(a) Pour into the pail two quarts of sand, or water, as instructed by your teacher.

Look carefully at the amount, and try to remember the size of *half a gallon*.

(b) Now pour into the pail two more quarts, making four altogether. Notice the amount.

(c) Empty the pail, and then put into it *what you consider to be a gallon*.

Test its correctness by emptying quart by quart.

Find the amount of your error.

(d) In the same way estimate $\frac{1}{2}$ gallon, $\frac{3}{4}$ gallon, and test your results.

SECTION IV.—WEIGHT.

38. The Pound Weight.

(a) Place a 1 lb. weight on one side of a pair of scales.

(b) Place 2 oz. weights, or bags, one at a time, on the opposite side of the scales, until they balance.

(c) Write your result down thus :

$$\begin{array}{rcl} 1 \text{ lb.} & = & \text{weights of 2 ozs.} \\ \therefore 1 \text{ lb.} & = & \text{ozs.} \end{array}$$

39. Weights of Objects.

(a) Find the weight of your reading-book, by means of the spring balance.

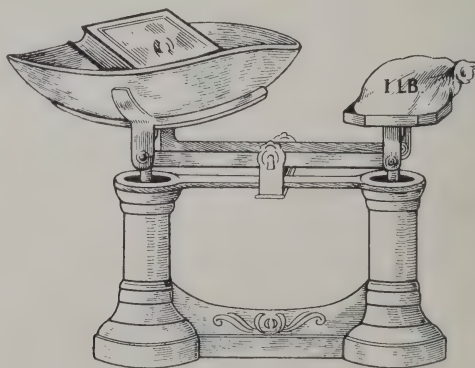


FIG. 20.

(b) Does it weigh more or less than 1 lb. ?

(c) Find by how many ounces it is heavier or lighter than 1 lb.

(d) Now place your reading-book on one side of a pair of scales, and 1 lb. weight on the other (Fig. 20).

(e) Add to the lighter side sand-bags of 1 oz. weight till the scales balance.

Enter your results thus :

Object.	Weight.	Its Weight compared with 1 lb.
Book	13 ozs.	3 ozs. less

(f) Repeat the exercise with other books.

40. Weight of Box of Sand.

(a) By means of the scales or spring balance, find the weight of the empty box given to you.

(b) Fill the box with sand, and weigh again.

(c) Find, by calculation, the weight of sand in the box.

(d) Now compare the weight of the sand with the weight of the empty box.

Which is heavier, and by how much ?

(e) Check your result by placing the empty box on one side of the scales, the sand on the other, and adding the required number of ounce weights to the lighter side.

Arrange your results thus :

Box.	Weight of Box.	Weight of Box and Sand.	Weight of Sand.	Comparison between Weights of Box and Sand.
3	3 ozs.	7 ozs.	4 ozs.	Sand 1 oz. heavier than Box.

(f) Repeat the exercise, using other boxes.

41. The Kilogram.

(a) Take a bag marked “ 500 grams,” and another marked “ kilogram.”

(b) Place them on opposite sides of the scales.

(c) Find how many of the smaller bags are required to balance the larger.

(d) What part of a kilogram is 500 grams ?

(e) Repeat the exercise, using 250 grams and 1 kilogram.

Enter your results thus :

(i) 500 grams = of kilogram.

(ii) 250 ,, = ,,

(f) How many grams make a kilogram ?

42. The Kilogram and Pound compared.

(a) Place a kilogram weight on the scales, and find its weight, as accurately as you can, in pounds and ounces.

(b) Find the nearest number of kilograms required to balance 7 lbs.

Record your results thus :

1 kilogram = lbs. ozs. (to nearest ounce).

$\therefore$ 1 kilogram = lbs. (roughly).

(c) Now calculate from the last result the number of kilograms in a stone, and add to your results.

43. Graph of Weight.

(a) Take your weight in stones and lbs. at regular intervals, and record on a graph.

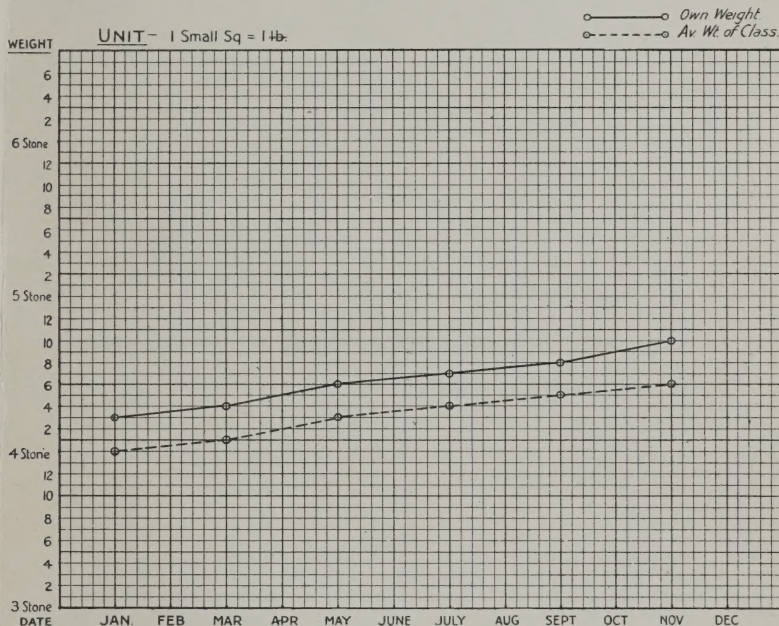


FIG. 21.—Graph of Weight.

(b) Insert the graph shewing the average weight of the class.

(c) By how much does your weight differ from the average weight?

SECTION V.—TIME.

44. Counting Seconds.

(a) Make the following table in your note-book :

	Number counted.	Actual Number of Seconds.	Nature of Counting.
<i>e.g.</i>	56	60	Too slow

(b) When told to commence, count silently one to a second as nearly as you can judge.

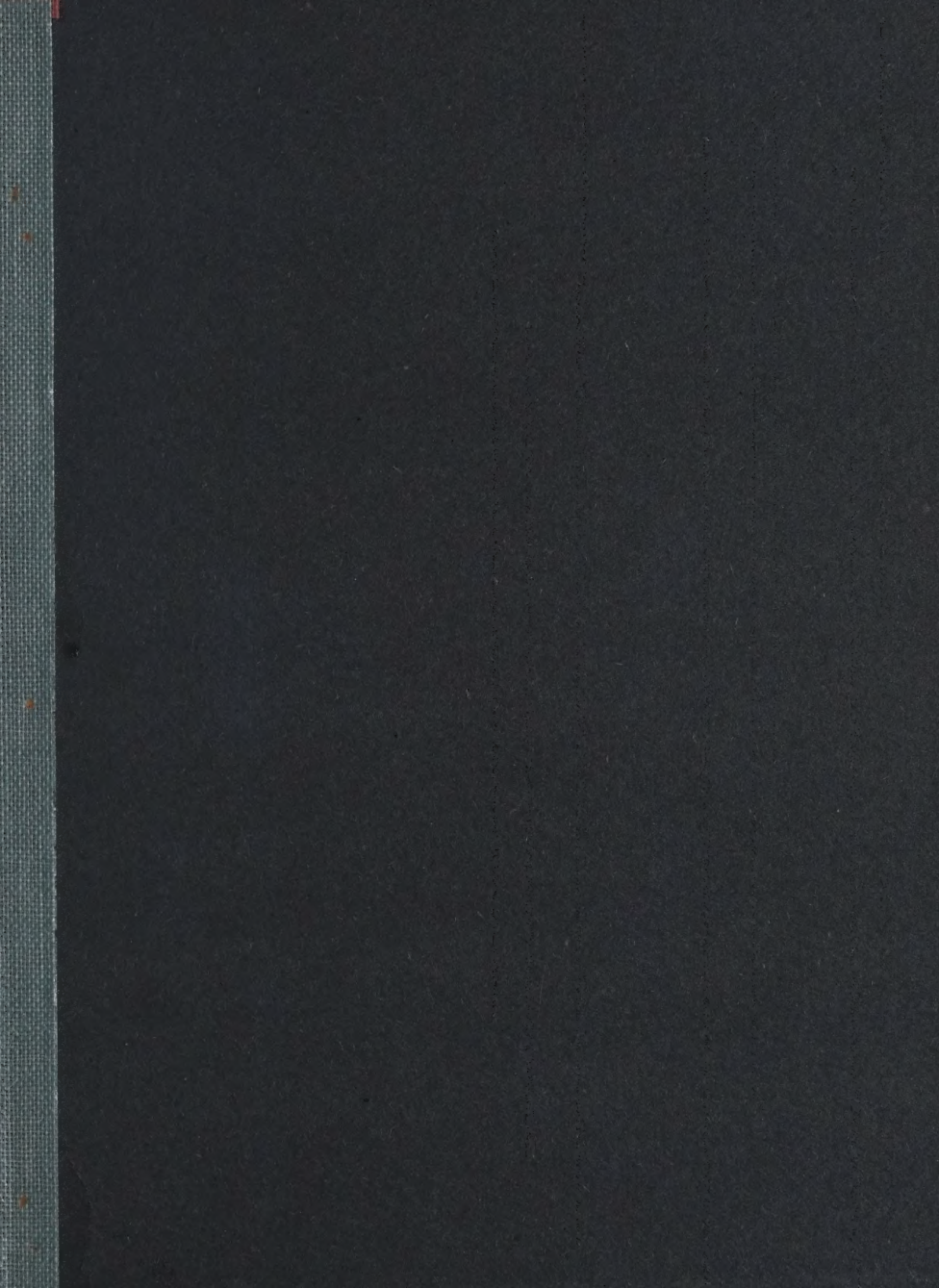
(c) When told to stop, place in the first column of your table the *last* number you counted.

(d) In the next column write down the number of seconds between “commence” and “stop,” which your teacher will tell you.

(e) Complete the table.

45. Counting Half-Seconds.

Repeat the above experiment, counting *two* to a second.



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BELL'S OUTDOOR AND INDOOR EXPERIMENTAL A



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